

Work Assignment No. 6
MTA Agreement No. 15099-0300

Utica Avenue Transit Improvements Study

Task 4 Deliverable: Ranking of Investment Package Options (IPOs) #4-#7

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Prepared for:



Submitted by:



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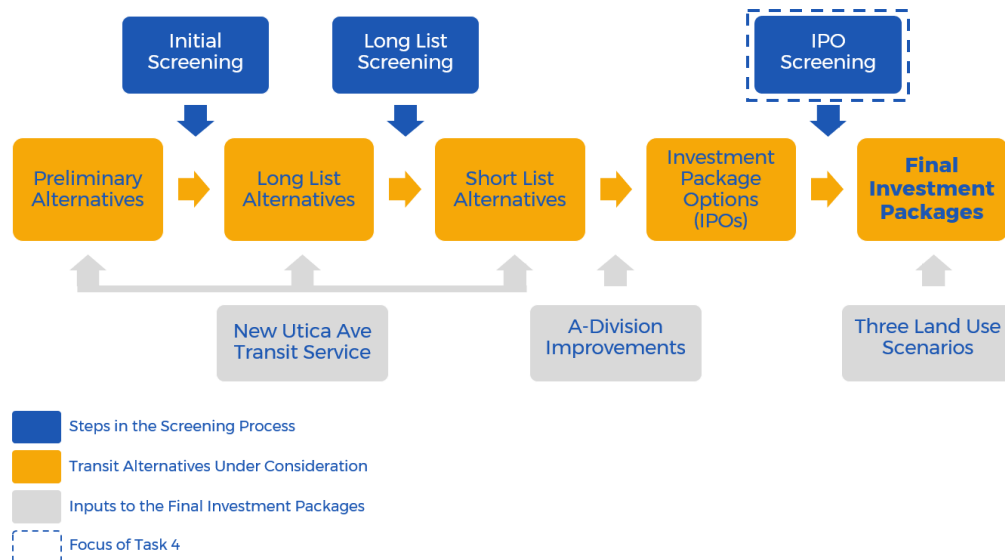
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1 Executive Summary

The purpose of the Utica Avenue Transit Improvements Study (Utica Ave Study) was to evaluate various modal and alignment options on Utica Ave and capacity improvements in the existing subway network—resulting in the selection of a set of Final Investment Packages for further consideration—to increase mobility and accessibility along, to, and from the Utica Ave corridor for a future horizon year 2035. This Task 4 report builds upon the work in Task 3, presenting the results of the first step in the screening of Investment Package Options (IPOs) and setting the stage for the work in Task 5 to select the Final Investment Packages. The overall alternatives development and screening process is shown on Figure ES1,¹ with the work discussed in this report inside the dotted line.

Figure ES1: Alternatives Development & Screening Process



Source: Utica Ave Study

Note: The Task 4 work—documented in this report—featured one of the steps in the screening of IPOs as shown inside the dotted line of this graphic. The preceding steps of the process were documented in the Task 3 deliverable, and the remaining steps were documented in the Task 5 deliverable.

¹ As depicted on Figure ES1 and discussed in the Task 3 report, the first several steps of the overall alternatives development and screening process included the definition and evaluation of a range of options for a new transit service along Utica Ave, which led to the identification of the Short List Alternatives. The next step in the alternatives development process—also documented in the Task 3 report—was to pair the Short List Alternatives for a new transit service along Utica Ave with A-Division improvements (and to consider A-Division improvements without a new transit service along Utica Ave), which were defined as IPOs.

As listed in Table ES1, 13 IPOs were defined to comprise a representative set of concepts for new transit service along Utica Ave paired with an associated A-Division operating plan. Table ES1 also highlights IPOs #4-#7, which served as the focal point of this report.

Table ES1: Summary of Investment Package Options (IPOs)

New Utica Ave Transit Service		A-Division Operating Plan	
Mode	From/To	CBTC Baseline	Modified Hybrid
N/A	N/A	N/A	IPO #1
BRT	Kings Plaza - Woodhull Hospital	IPO #2	IPO #3
Subway (A-Division Extension)	Kings Plaza - Eastern Parkway (Local Track Connection)	IPO #4	IPO #5
	Kings Plaza - Eastern Parkway (Express Track Connection)	IPO #6	IPO #7
Subway (B-Division Shuttle)	Kings Plaza - Fulton Street (Shuttle) <i>(designed to not preclude a northward extension to Broadway)</i>	IPO #8	IPO #9
BRT & Subway (A-Division Extension)	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Local Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #10	IPO #11
	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Express Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #12	IPO #13

Source: Utica Ave Study

Notes:

- IPO #1, which would introduce the Modified Hybrid Operating Plan on the A-Division, included a package of improvements to existing A-Division infrastructure.
- All subway IPOs could be fully underground or transition to aerial.

IPOs #4-#7 all featured an A-Division Extension to Kings Plaza but included different combinations of the track connection at Eastern Parkway (Local or Express) and the corresponding Operating Plan (CBTC Baseline or Modified Hybrid), reflected in different splits of peak trains per hour (TPH) both by line and by terminal for the Brooklyn A-Division services. The purpose of this report was to document a targeted comparison and ranking of IPOs #4-#7—based on a subset of evaluation criteria linked to the study goals and objectives that would allow decisions to be made among the IPOs—as a precursor to selecting the Final Investment Packages in Task 5.

As discussed in this report, there were several key drivers that informed the resultant ranking of IPOs #4-#7. A fundamental differentiator among the IPOs was that IPOs #5 and #7 would be preferable because they eliminate the Nostrand Junction chokepoint, whereas IPOs #4 and #6 do not. In comparing IPOs #5 and #7, IPO #5 emerged as a more favorable option based on several metrics, including end terminal on-time performance (OTP) to Kings Plaza, end terminal OTP for the

overall Brooklyn A-Division,² and the fact that this was the only IPO that would offer a one-seat ride from Kings Plaza to both the East Side and West Side of Manhattan. For these reasons, IPO #5 was identified as the top ranked IPO and IPO #7 was ranked second among the four IPOs.

IPO #4 was the least attractive option among the four IPOs because it would result in a reduction in service frequency from Kings Plaza compared to the B46 Select Bus Service (SBS) in the No-Build Alternative. Although IPO #4 performed better than IPO #6 for most metrics, the reduction in service frequency associated with IPO #4 rendered this option the least preferable among IPOs #4-#7. As such, IPO #6 was ranked third and IPO #4 was ranked fourth among the four IPOs.³

In summary, the recommended ranking of IPOs #4-#7 was as follows:

- **First: IPO #5** (Local Track Connection with Modified Hybrid Operating Plan);
- **Second: IPO #7** (Express Track Connection with Modified Hybrid Operating Plan);
- **Third: IPO #6** (Express Track Connection with CBTC Baseline Operating Plan); and
- **Fourth: IPO #4** (Local Track Connection with CBTC Baseline Operating Plan).

Building upon the work in this report, the subsequent work in Task 5 documented the process of selecting the Final Investment Packages and the resultant ridership forecasts using all three Land Use Scenarios defined earlier in the study. The recommendations for the Final Investment Packages were informed by the ranking of IPOs #4-#7 and a targeted comparison of all 13 IPOs, with the intended outcome of a wide range of investment levels and concepts for improving transit service along, to, and from Utica Ave.

² The overall Brooklyn A-Division corresponds to all lines terminating at Kings Plaza, Flatbush Av Terminal, and New Lots Av Terminal.

³ While IPOs #4 and #6 were ranked the lowest of the four IPOs because they would not address the Nostrand Junction chokepoint, no IPOs were eliminated in Task 4. However, the ranking of IPOs #4-#7 subsequently informed the selection of the Final Investment Packages in Task 5.

2 Introduction

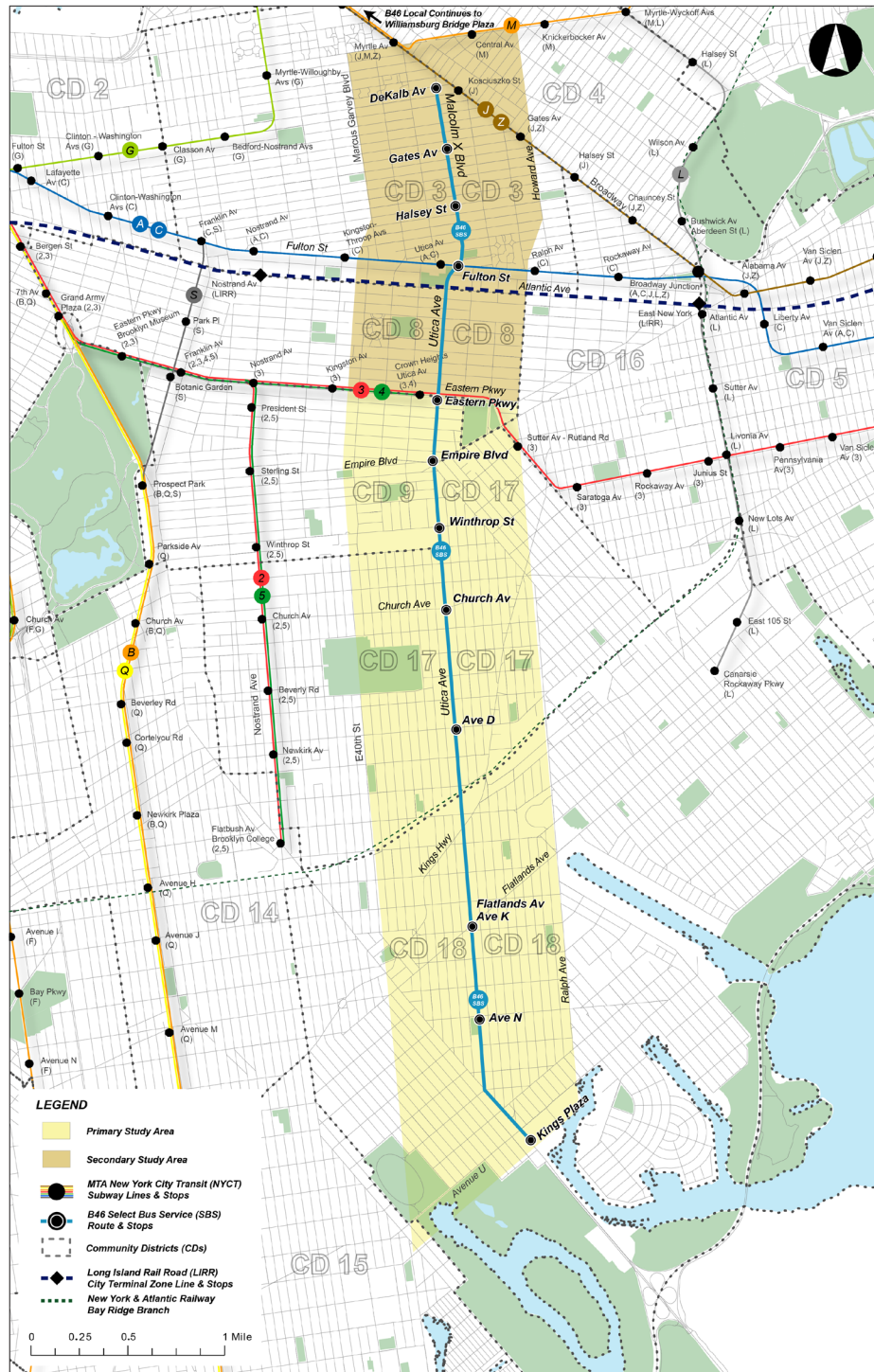
The purpose of the Utica Avenue Transit Improvements Study (Utica Ave Study) was to evaluate various modal and alignment options on Utica Ave and capacity improvements in the existing subway network—resulting in the selection of a set of Final Investment Packages for further consideration—to increase mobility and accessibility along, to, and from the Utica Ave corridor for a future horizon year 2035. Alternatives were defined in this study to address the need for transit improvements to increase reliability, reduce travel times, enhance connectivity, and accommodate future growth. In using an alternatives analysis process, the end product of the study was a set of Final Investment Packages corresponding to a range of service concepts and investment levels for transit improvements that addressed the study purpose and need and achieved the study goals and objectives.

This Task 4 report builds upon the work in Task 3, presenting the results of the first step in the screening of Investment Package Options (IPOs) and setting the stage for the work in Task 5 to select the Final Investment Packages.

3 Study Area

As shown on Figure 1, the Study Area for the Utica Ave Study extended from Avenue V in the south to Myrtle Avenue in the north, incorporating an approximately half-mile buffer around the Utica Ave corridor, which becomes Malcolm X Boulevard north of Fulton Street. The Study Area was divided into Primary and Secondary Study Areas. The Primary Study Area was bounded by Eastern Parkway to the north, Ralph Avenue to the east, Avenue V to the south, and East 40th Street to the west. This area served as the main focus in the study of options to improve transit service and mobility along the Utica Avenue corridor. A Secondary Study Area contained additional opportunities for transit improvements along the northern portion of the corridor, extending from the Primary Study Area's northern boundary to Myrtle Avenue, which is several blocks north of the terminus for the existing B46 Select Bus Service (SBS).

Figure 1: Utica Ave Study Area



Source: Utica Ave Study

4 Summary of Alternatives Development & Screening Process

The transit improvement alternatives under consideration in this study included multiple options covering multiple modes for a new service along the Utica Ave corridor, plus consideration for targeted investments to the A-Division of the subway system that could enhance access to and from the corridor. Additionally, a No-Build Alternative was defined as a baseline for comparing the anticipated benefits and potential impacts of the Build Alternatives through a multi-tiered screening process.⁴ The following sections present an overview of the types of transit improvements under consideration in this study and the screening process that was used to inform the selection of Final Investment Packages.

4.1 BACKGROUND: TYPES OF TRANSIT IMPROVEMENTS UNDER CONSIDERATION

As depicted on Figure 2, Utica Ave transit improvements could come in two forms:

- Improving mobility along Utica Ave by introducing a new transit service to replace the existing B46 SBS; and
- Improving access to/from Utica Ave through targeted investments to the A-Division (while avoiding a degradation of other A-Division services in Brooklyn).

The Build Alternatives for the first type of transit improvement (i.e., along Utica Ave) included a number of different modal and alignment options for a new transit service, including combinations of potential northern and southern termini as well as variants based on operational/design characteristics. The study also identified options to improve transit access to/from Utica Ave by increasing the existing A-Division capacity and operational flexibility in eastern Brooklyn.⁵ This included opportunities along the Eastern Parkway, New Lots Avenue, and Nostrand Avenue Lines of the subway to alleviate existing constrained conditions pertaining to train operation bottlenecks and shortage of train storage or lay-up capability. The A-Division locations are shown on Figure 2 and correspond to Nostrand Junction, Flatbush Avenue Terminal, Crown Heights-Utica Avenue Station, New Lots Avenue Terminal, and Livonia and Linden Yards.

⁴ The No-Build Alternative was defined to include transportation network improvements expected to exist in the 2035 horizon year. For instance, the No-Build Alternative included Long Island Rail Road (LIRR) East Side Access, Metro-North Railroad Penn Station Access, and Phase 2 of the Second Avenue Subway. The No-Build Alternative also included improvements to travel times and average headways on the A-Division due to the installation of Communications-Based Train Control (CBTC), as well as a number of capital improvements and operational changes to enhance the existing B46 SBS. Additional details about the No-Build Alternative were included in the Task 3 report.

⁵ As discussed in Section 4.2, the first several steps of the screening process focused on evaluating options for a new transit service along Utica Ave, followed by consideration of A-Division improvements.

Figure 2: Opportunities for Transit Improvements Along and To/From Utica Ave



Source: Utica Ave Study

Note: Opportunities for transit improvements along and to/from Utica Ave are denoted by bold arrows

Both types of improvements (i.e., a new transit service on Utica Ave and targeted investments to the A-Division) could have independent utility by enhancing service along or to/from Utica Ave. The improvements could also be complementary, with possible synergies generating additional benefits, for instance with respect to travel time savings and ridership potential. The result of the study—subsequently documented in the Task 5 report—was the selection of Final Investment Packages, each of which could include one or both types of improvements, as discussed in the next section.

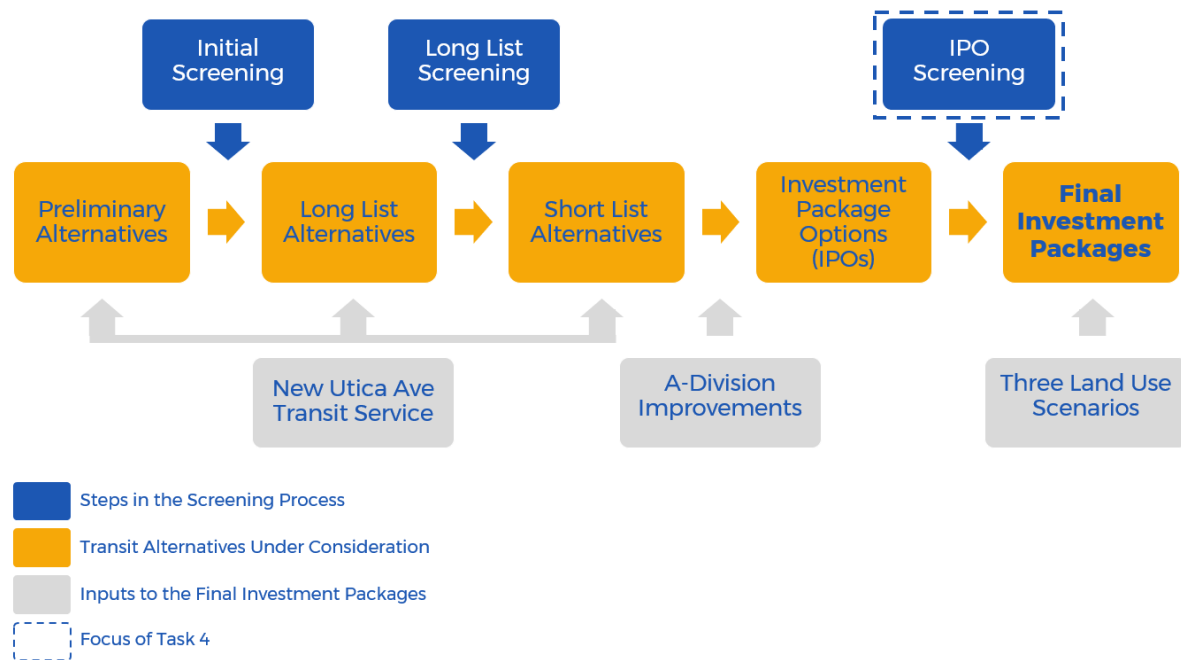
4.2 SCREENING PROCESS TO INFORM SELECTION OF FINAL INVESTMENT PACKAGES

The Utica Ave Study included a multi-tiered screening process to evaluate the wide range of alternatives under consideration for a new transit service along Utica Ave, ultimately leading to the identification of multiple Final Investment Packages—with consideration for improvements to the A-Division—that met the study goals and objectives. The study goals and objectives provided the foundation for the evaluation of alternatives to achieve the purpose and need. The study goals were as follows:

1. Improve mobility and connectivity through the provision of new or enhanced transit options
2. Maximize consistency with local and regional plans
3. Enhance access to employment and activity centers and support economic growth
4. Maximize operational and cost effectiveness
5. Minimize adverse environmental impacts
6. Promote a resilient and redundant transit network

At each stage of the multi-tiered screening process, evaluation criteria were defined and applied to compare the extent to which the alternatives achieved the study goals and objectives. The alternatives development and screening process is shown on Figure 3, with the work discussed in this report inside the dotted line.

Figure 3: Alternatives Development & Screening Process



Source: Utica Ave Study

Note: The Task 4 work—documented in this report—featured one of the steps in the screening of IPOs as shown inside the dotted line of this graphic. The preceding steps of the process were documented in the Task 3 deliverable, and the remaining steps were documented in the Task 5 deliverable.

As discussed in the Task 3 report and depicted on Figure 3, the first several steps of the alternatives development and screening process included the definition and evaluation of a range of options for a new transit service along Utica Ave, which led to the identification of the Short List Alternatives. The next step in the alternatives development process—also documented in the Task 3 report—was to pair the Short List Alternatives for a new transit service along Utica Ave with A-Division improvements (and to consider A-Division improvements without a new transit service along Utica Ave), which were defined as Investment Package Options (IPOs).

The selection of the Final Investment Packages—subsequently documented in Task 5—was informed by the screening of IPOs, which is discussed in the following section. Also in Task 5, the ridership potential of the Final Investment Packages was tested with three different Land Use Scenarios that correspond to incremental increases in population and employment along the corridor in the 2035 horizon year.

Overall, while generally following an alternatives analysis process, the study did not identify a single locally preferred alternative (LPA), but rather a number of Final Investment Packages that reflect a range of investment levels and options for improving transit along, to, and from Utica Ave.⁶

⁶ As discussed in the Task 5 report, a targeted comparison of the 13 IPOs (using a subset of evaluation criteria linked to the study goals and objectives) demonstrated that while several differentiators emerged, no individual IPO performed the best across all metrics. As such, the comparison supported the outcome of this study as a set of Final Investment Packages as opposed to a single LPA. Refer to the Task 5 report for additional details.

5 Definition of Investment Package Options (IPOS) and IPO Screening Methodology

As discussed in the Task 3 report, 13 IPOs were defined that built upon the Short List Alternatives and comprised a representative set of concepts for new transit service along Utica Ave paired with an associated A-Division operating plan (Table 1). Details about the 13 IPOs—including operational assumptions—were presented in a set of Task 3 Appendices.

Table 1: Summary of Investment Package Options (IPOS)

New Utica Ave Transit Service		A-Division Operating Plan	
Mode	From/To	CBTC Baseline	Modified Hybrid
N/A	N/A	N/A	IPO #1
BRT	Kings Plaza - Woodhull Hospital	IPO #2	IPO #3
Subway (A-Division Extension)	Kings Plaza - Eastern Parkway (Local Track Connection)	IPO #4	IPO #5
	Kings Plaza - Eastern Parkway (Express Track Connection)	IPO #6	IPO #7
Subway (B-Division Shuttle)	Kings Plaza - Fulton Street (Shuttle) <i>(designed to not preclude a northward extension to Broadway)</i>	IPO #8	IPO #9
BRT & Subway (A-Division Extension)	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Local Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #10	IPO #11
	BRT: Kings Plaza - Woodhull Hospital Subway: Church Av - Eastern Parkway (Express Track Connection) <i>(designed to not preclude a southward extension to Kings Plaza)</i>	IPO #12	IPO #13

Source: Utica Ave Study

Notes:

- IPO #1, which would introduce the Modified Hybrid Operating Plan on the A-Division, included a package of improvements to existing A-Division infrastructure.
- All subway IPOs could be fully underground or transition to aerial.

Following the definition of the 13 IPOs, a set of quantitative and qualitative evaluation criteria—linked to the study goals and objectives—was established to inform the selection of Final Investment Packages from the IPOs. All of the evaluation criteria were important and collectively demonstrated the extent to which each IPO achieved the study goals and objectives against the baseline of the No-Build Alternative. There were 35 evaluation criteria in total, and a subset of the criteria was identified that would drive the recommendations for the Final Investment Packages. These criteria and the corresponding goals and objectives were listed in the Task 3 report.

The technical work to support the evaluation of IPOs was completed and documented in the Task 3 report, and the screening of the IPOs to inform the selection of the Final Investment Packages was completed in two steps, as follows:

- Task 4 (documented in this report): ranking of IPOs #4-#7 based on the applicable criteria for comparing different operational scenarios of an A-Division Extension along Utica Ave from Eastern Parkway to Kings Plaza; and
- Task 5: selection of the Final Investment Packages as informed by the ranking of IPOs #4-#7 in Task 4, the evaluation of all 13 IPOs, and the intent to offer a range of investment levels and service concepts for the Utica Ave transit improvements. This task also included ridership forecasts for the Final Investment Packages paired with three potential future Land Use Scenarios.

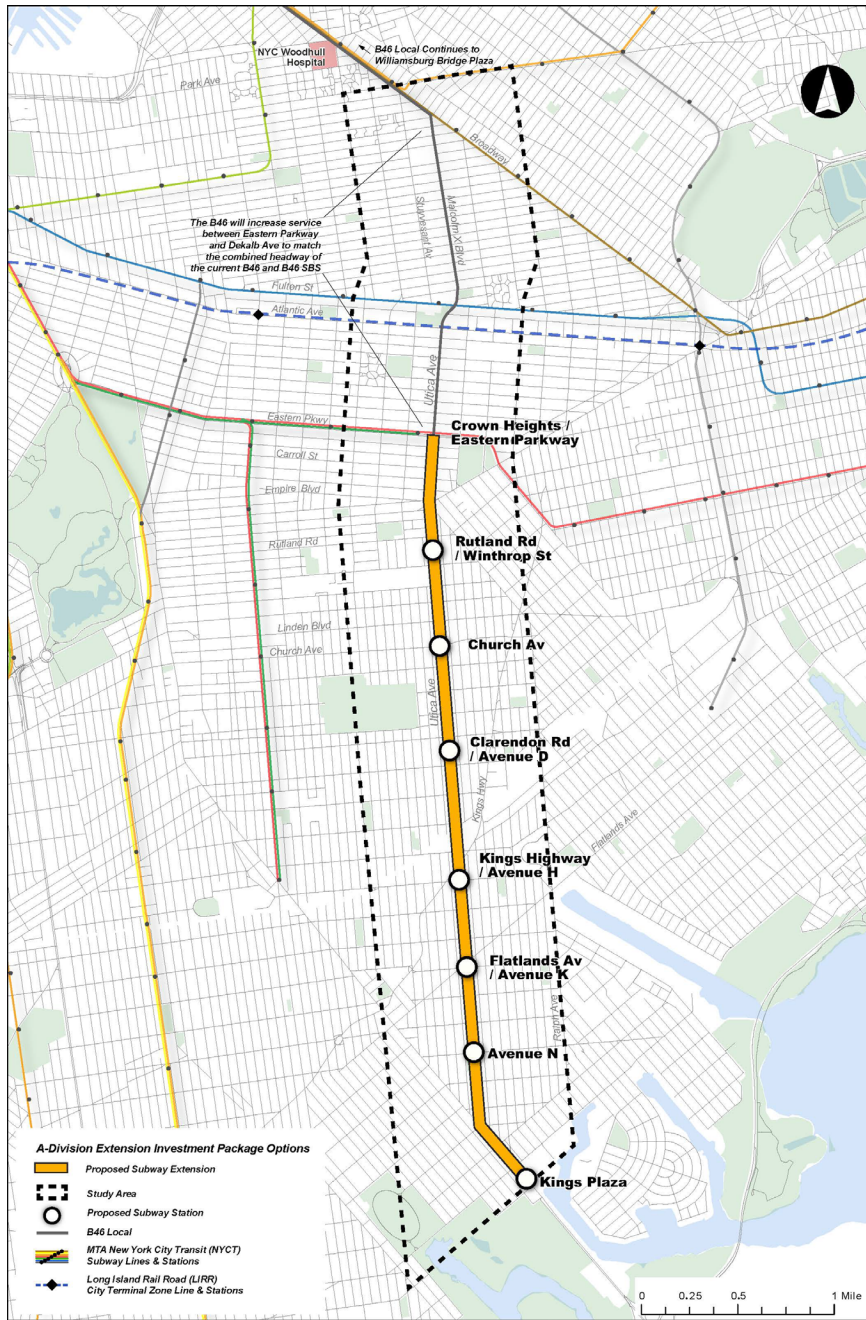
6 Overview of IPOs #4-#7: A-Division Extension to Kings Plaza

As shown on Figure 4, IPOs #4-#7 all include an A-Division Extension south along Utica Ave from Crown Heights-Utica Av Station on the Eastern Parkway Line to a new terminus at Kings Plaza.

The four IPOs include different combinations of the track connection at Eastern Parkway (Local or Express) and the corresponding A-Division Operating Plan (CBTC Baseline or Modified Hybrid). A schematic representation of the track connection options at Eastern Parkway is shown on Figure 5.⁷ For each of the two track connection options, the CBTC Baseline and Modified Hybrid Operating Plans differed with respect to the split of peak trains per hour (TPH) both by line and by terminal for the Brooklyn A-Division services. This resulted in four different operational scenarios for an A-Division Extension to Kings Plaza, as shown in Table 2 and discussed in the following sections.

⁷ Refer to “Task 3 Appendix 2B: Utica Ave Subway Alignment Descriptions & Representative Concept Plans” for alignment descriptions and concept plans for the A-Division Extension options. All of the alignments to accommodate the operating plans discussed herein could remain fully underground or transition to an aerial guideway in the vicinity of Empire Boulevard.

Figure 4: IPOs #4 - #7 — A-Division Extension Along Utica Ave





Source: Utica Ave Study

Table 2: Summary of Operational Scenarios for IPOs #4-#7

Description		Peak Trains Per Hour (TPH) by Line and Southern Terminal (for Brooklyn A-Division)				Total TPH, All Lines & Terminals
		To Flatbush Av	To Crown Heights- Utica Av	To Kings Plaza	To New Lots Av	
No-Build Alternative		2 : 13 TPH 5 : 7 TPH (Total: 20 TPH)	4 : 13 TPH 5 : 6 TPH (Total: 19 TPH)*	N/A	3 : 13 TPH (Total: 13 TPH)	52 TPH*, **
Build Alternatives: A-Division Extension Operational Scenarios	Local Track Connection with <u>CBTC Baseline</u> Operating Plan (IPO #4)	2 : 13 TPH 5 : 7 TPH (Total: 20 TPH)	N/A	3 : 13 TPH (Total: 13 TPH)	4 : 23 TPH (Total: 23 TPH)	56 TPH
	Express Track Connection with <u>CBTC Baseline</u> Operating Plan (IPO #6)	2 : 13 TPH 5 : 7 TPH (Total: 20 TPH)	N/A	4 : 23 TPH (Total: 23 TPH)	3 : 13 TPH (Total: 13 TPH)	56 TPH
	Local Track Connection with <u>Modified Hybrid</u> Operating Plan (IPO #5)***	2 : 12 TPH 3 : 12 TPH (Total: 24 TPH)	N/A	4 : 7 TPH 5 : 10 TPH 8 : 6 TPH (Total: 23 TPH)	4 : 13 TPH (Total: 13 TPH)	60 TPH
	Express Track Connection with <u>Modified Hybrid</u> Operating Plan (IPO #7)***	2 : 12 TPH 3 : 12 TPH (Total: 24 TPH)	N/A	4 : 20 TPH 5 : 3 TPH (Total: 23 TPH)*	5 : 7 TPH 8 : 6 TPH (Total: 13 TPH)*	60 TPH

Source: Utica Ave Study

Notes:

*This table shows the TPH by line and southern terminal for the ridership forecasts. Below is a summary of differences from the rail simulations:

-No-Build Alternative: To Crown Heights-Utica = 23 TPH for **4** and 0 TPH for **5** (total 23 TPH); Total TPH, All Lines & Terminals = 56 TPH-IPO #7: To Kings Plaza = 20 TPH for **4** and 0 TPH for **5** (total 20 TPH); To New Lots = 10 TPH for **5** and 6 TPH for **8** (total 16 TPH)

** An additional 3 TPH combined for the East Side IRT would terminate in Manhattan (with the Bronx - Bowling Green short-turn) for the No-Build Alternative.

***The Modified Hybrid Operating Plan would introduce a new **8** line to enable the West Side IRT to continue providing some service to New Lots Av Terminal (for the Express Track Connection) or provide service to Kings Plaza (for the Local Track Connection).

7 Ranking of IPOs #4-#7

A subset of evaluation criteria identified in Task 3 was used to inform a targeted comparison and corresponding ranking of IPOs #4-#7 (documented in this deliverable) as a precursor to selecting the Final Investment Packages (documented in the Task 5 deliverable).⁸ The following comparison was organized around key themes (i.e., Nostrand Junction operations, service along and to/from Utica Ave, etc.) that emerged from the subset of criteria and allowed decisions to be made among the IPOs.

7.1 TARGETED COMPARISON OF IPOs #4-#7

Several metrics helped to differentiate the four IPOs, starting with the overarching consideration of addressing the chokepoint at Nostrand Junction. The comparison also considered operational metrics associated with the provision of service both along and to/from Utica Ave, including implications for other Brooklyn A-Division services (i.e., to/from Flatbush Av Terminal and New Lots Av Terminal). Additionally, ridership forecasts, order-of-magnitude cost estimates, and the corresponding assessment of cost effectiveness also informed the ranking of IPOs #4-#7.

The following sections present the results of these comparisons, followed by the recommended ranking of the four IPOs. The metrics for each IPO are color-coded for ease of reference relative to the No-Build Alternative (if applicable), and specifically to differentiate between positive and negative changes compared to the No-Build Alternative.

Nostrand Junction Operations

One of the key considerations in the comparison of IPOs #4-#7 was whether the respective IPO would address the Nostrand Junction chokepoint, which would also help to support long-term A-Division service growth in Brooklyn and across the network. The existing chokepoint at Nostrand Junction, which would remain in the No-Build Alternative, imposes a substantial constraint on A-Division operations. The source of the chokepoint is the short section of track (less than 200 feet) that is shared by the 2, 3, and 5 and accommodates the merging and diverging moves of the 2 and 5 to serve Flatbush Av Terminal (Figure 6). This short section of track caps the maximum frequency of these services, requires that their schedules be closely linked, and introduces additional delay when there are schedule deviations.

As shown on Figure 6, IPOs #4 and #6, which include the CBTC Baseline Operating Plan, would not eliminate the chokepoint at Nostrand Junction. The CBTC Baseline Operating Plan would maintain

⁸ The Task 3 report (and “Task 3 Appendix 4: IPO Evaluation Results”) presented the evaluation of all 13 IPOs using the 35 criteria linked to the goals and objectives that were defined in the study, and also identified the subset of criteria that would drive the recommendations for the Final Investment Packages.

② and ⑤ service at Flatbush Av Terminal with a corresponding 20 TPH at this station and a maximum of 56 TPH for the overall Brooklyn A-Division.⁹ In contrast, IPOs #5 and #7 include the Modified Hybrid Operating Plan, which would eliminate the Nostrand Junction chokepoint and thereby enable service delivery of 24 TPH to Flatbush Av Terminal (with ② and ③ service) and a total of 60 TPH for the overall Brooklyn A-Division.

The schematic graphics on Figure 6 show the differences in Nostrand Junction operations between the two operating plans, most notably the fact that the chokepoint due to merging and diverging conflicts would continue to exist with the CBTC Baseline Operating Plan under IPOs #4 and #6.



Source: Utica Ave Study

New Service along Utica Ave

Table 3 shows the service characteristics for the four IPOs—specifically pertaining to the new service along Utica Ave—compared to the No-Build Alternative. A noteworthy difference among the IPOs was that whereas IPOs #5-#7 would offer increased service frequency to Kings Plaza compared to the No-Build Alternative, IPO #4 would result in a reduction of service frequency. In offering 23 TPH to Kings Plaza in the peak period, IPOs #5-#7 would provide customers with an approximately 2.6-minute headway, which would be an improvement over the 3-minute headways provided by the B46 SBS in the No-Build Alternative. In contrast, IPO #4 would only offer 13 TPH to Kings Plaza, thereby resulting in an approximately 4.6-minute headway and corresponding longer scheduled wait times for customers compared to the B46 SBS in the No-Build Alternative.¹⁰

⁹ The overall Brooklyn A-Division corresponds to all lines terminating at Kings Plaza, Flatbush Av Terminal, and New Lots Av Terminal.

¹⁰ It should be noted that while the scheduled headway for IPO #4 would result in longer scheduled wait times compared to the No-Build Alternative, the capacity of the rolling stock is orders of magnitude greater for IPO

Table 3: Service Characteristics and Travel Time Along Utica Ave for IPOs #4-#7

	No-Build	IPO #4 CBTC Baseline	IPO #5 Modified Hybrid	IPO #6 CBTC Baseline	IPO #7 Modified Hybrid
		Local Track Connection		Express Track Connection	
TPH to Kings Plaza (peak service frequency/headway)	N/A (3 min for B46 SBS)	13 (4.6 min)	23 (2.6 min)	23 (2.6 min)	23 (2.6 min)
End Terminal OTP for Subway Lines to Kings Plaza based on 5-minute Lateness Threshold	N/A	99.7%	98.7%	87.1%	89.6%
Average Travel Time from Kings Plaza to Eastern Parkway (savings compared to No-Build)	30 min (via B46 SBS)	20-21 minutes (9-10 minutes of savings)			

Source: Utica Ave Study

Note: Travel time calculation incorporates station access/egress, initial transfer and wait time, transfer walk time, and in-vehicle times.

Among those IPOs with increased service frequency to Kings Plaza compared to the No-Build Alternative (i.e., IPOs #5-#7), IPO #5 would offer a substantially higher end terminal on-time performance (OTP) for the subway lines to Kings Plaza based on a 5-minute lateness threshold. As shown in Table 3, IPO #5 would offer 98.7% end terminal OTP, compared to 87.1% and 89.6% for IPOs #6 and #7, respectively.

While service frequency and end terminal OTP were differentiators among IPOs #4-#7, there were no significant differences for the four IPOs in average travel time from Kings Plaza to Eastern Parkway in the Primary Study Area.¹¹ By introducing A-Division service along Utica Ave, all four IPOs would offer approximately 9-10 minutes in travel time savings compared to the B46 SBS in the No-Build Alternative (i.e., 20-21 minutes in travel time compared to 30 minutes in travel time, respectively).¹²

#4 (i.e., A-Division trains) than the No-Build Alternative (i.e., articulated buses for the B46 SBS). The substantially greater capacity offered by IPO #4—even at longer headways—could potentially eliminate a scenario with the No-Build Alternative in which a customer is unable to board a bus that is at capacity and thus would have to wait another headway for the next bus.

¹¹ Similarly, average travel time from Kings Plaza to destinations in the Secondary Study Area did not serve as a differentiator among these four IPOs, whereas this comparison revealed noteworthy differences among all 13 IPOs, which were subsequently discussed in the Task 5 deliverable.

¹² “Task 3 Appendix 3: Operational Inputs & Ridership Forecasts for the IPOs” provided insight into the relative number of customers that would benefit from the travel time savings from Kings Plaza. Specifically, Task 3 Appendix 3 included a summary of linked transit trips at the SuperZone level (corresponding to an aggregation of Transportation Analysis Zones [TAZ]), including a different tabulation for the No-Build Alternative and each IPO (using Land Use Scenario #2).

A-Division Service to/from Utica Ave & Implications for Other Brooklyn A-Division Services

In comparing the IPOs based on the A-Division service provided to/from Utica Ave—while also considering operational implications for other Brooklyn A-Division services—several key metrics were evaluated for Crown Heights-Utica Av Station, Flatbush Av Terminal, and New Lots Av Terminal. The first metric was the number of TPH that would serve each station.

As shown in Table 4, the number of TPH that would serve Crown Heights-Utica Av Station (i.e., all trains terminating at Kings Plaza or New Lots Av Terminal) was not a differentiator among IPOs #4-#7. All four IPOs would offer 36 TPH to Crown Heights-Utica Av Station, representing a slight improvement in service frequency from 1.9 minutes in the No-Build Alternative (i.e., 32 TPH) to 1.7 minutes for each IPO.

In contrast to the identical service delivery to Crown Heights-Utica Av Station, the IPOs would differ with respect to TPH to Flatbush Av Terminal and New Lots Av Terminal. Specifically, as shown in Table 4, IPOs #5 and #7 would offer more frequent service to Flatbush Av Terminal—and IPO #4 would offer more frequent service to New Lots Av Terminal—compared to the No-Build Alternative.¹³

Table 4: Peak TPH and Service Frequency for IPOs #4-#7

		No-Build	IPO #4 CBTC Baseline	IPO #5 Modified Hybrid	IPO #6 CBTC Baseline	IPO #7 Modified Hybrid
			Local Track Connection		Express Track Connection	
TPH serving each station (frequency/headway)	Crown Heights-Utica Av	32 TPH (1.9 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)	36 TPH (1.7 min)
	Flatbush Av	20 TPH (3 min)	20 TPH (3 min)	24 TPH (2.5 min)	20 TPH (3 min)	24 TPH (2.5 min)
	New Lots Av	13 TPH (4.6 min)	23 TPH (2.6 min)	13 TPH (4.6 min)	13 TPH (4.6 min)	13 TPH (4.6 min)

Source: Utica Ave Study

A second metric of interest was the extent to which the IPOs would result in changes in travel time for subway customers traveling north of Crown Heights-Utica Av Station or from Flatbush Av Terminal or New Lots Av Terminal. This metric was evaluated by comparing weighted average (local/express) travel time from each of these three stations to Nevins Street, which corresponded to the northern limits of the rail simulation model for the West Side IRT, and also offered insight into travel time through Nostrand Junction. Based on the outputs from the rail simulation model, all four IPOs would improve travel time from Crown Heights-Utica Av Station, with IPO #7 offering the greatest travel time savings (Table 5). Additionally, all IPOs would improve travel time from New Lots Av Terminal—with IPOs #4 and #5 offering the

¹³ It is important to note that for each IPO, the service frequencies at the A-Division southern termini were the result of total TPH scheduled for each line and the service design in Brooklyn, and were not necessarily representative of demand along the respective branches.

greatest travel time savings—and all IPOs would result in a modest increase in travel time from Flatbush Av Terminal.¹⁴

Table 5: Weighted Average (Local/Express) Travel Time to Nevins Street for IPOs #4-#7

		No-Build	IPO #4 CBTC Baseline	IPO #5 Modified Hybrid	IPO #6 CBTC Baseline	IPO #7 Modified Hybrid
			Local Track Connection		Express Track Connection	
From Crown Heights-Utica Av	Travel time to Nevins St	9:19	8:54	8:55	9:04	8:23
	Difference compared to No-Build (%)	N/A	-00:25 (-4%)	-00:24 (-4%)	-00:15 (-3%)	-00:56 (-10%)
From Flatbush Av	Travel time to Nevins St	17:27	17:36	17:54	17:35	18:03
	Difference compared to No-Build (%)	N/A	+00:09 (1%)	+00:27 (3%)	+00:08 (1%)	+00:36 (3%)
From New Lots Av	Travel time to Nevins St	22:22	18:10	18:20	22:09	19:54
	Difference compared to No-Build (%)	N/A	-04:12 (-19%)	-04:02 (-18%)	-00:13 (-1%)	-02:28 (-11%)

Source: Utica Ave Study

Note: Travel time corresponds to a weighted average of local and express service as applicable. Travel time is local only for the No-Build.

In addition to comparing end terminal OTP for the subway lines serving Kings Plaza (discussed in the previous section as a metric pertaining to service along Utica Ave), it was also important to evaluate the end terminal OTP to Flatbush Av Terminal, New Lots Av Terminal, and for the overall Brooklyn A-Division to establish a holistic understanding of the implications of the four IPOs for other Brooklyn A-Division services. As shown in Table 6, IPOs #4-#7 would all improve end terminal OTP for Flatbush Av Terminal and show minimal change for New Lots Av Terminal. IPOs #4 and #5 would both improve end terminal OTP for the overall Brooklyn A-Division, with IPO #5 also providing additional TPH compared to IPO #4 (i.e., 60 TPH vs. 56 TPH, respectively). Unlike IPOs #4 and #5, IPOs #6 and #7 showed a decrease in end terminal OTP for the overall Brooklyn A-Division, although IPO #7 would provide an increase in total TPH compared to the No-Build Alternative (i.e., 60 TPH vs. 56 TPH).

Table 6: End Terminal OTP Based on 5-minute Lateness Threshold for IPOs #4-#7

	No-Build	IPO #4 CBTC Baseline	IPO #5 Modified Hybrid	IPO #6 CBTC Baseline	IPO #7 Modified Hybrid
		Local Track Connection		Express Track Connection	
End Terminal OTP to Flatbush Av (difference from No-Build)	98.5%	100.0% (1.5% improvement)	99.7% (1.2% improvement)	99.2% (0.7% improvement)	100.0% (1.5% improvement)
End Terminal OTP to New Lots Av (difference from No-Build)	99.0%	99.6% (0.6% improvement)	99.5% (0.5% improvement)	99.4% (0.4% improvement)	98.6% (0.4% decrease)
End Terminal OTP for Overall Brooklyn A-Division (difference from No-Build)	97.9%	99.8% (1.9% improvement)	99.3% (1.4% improvement)	94.8% (3.1% decrease)	96.4% (1.5% decrease)

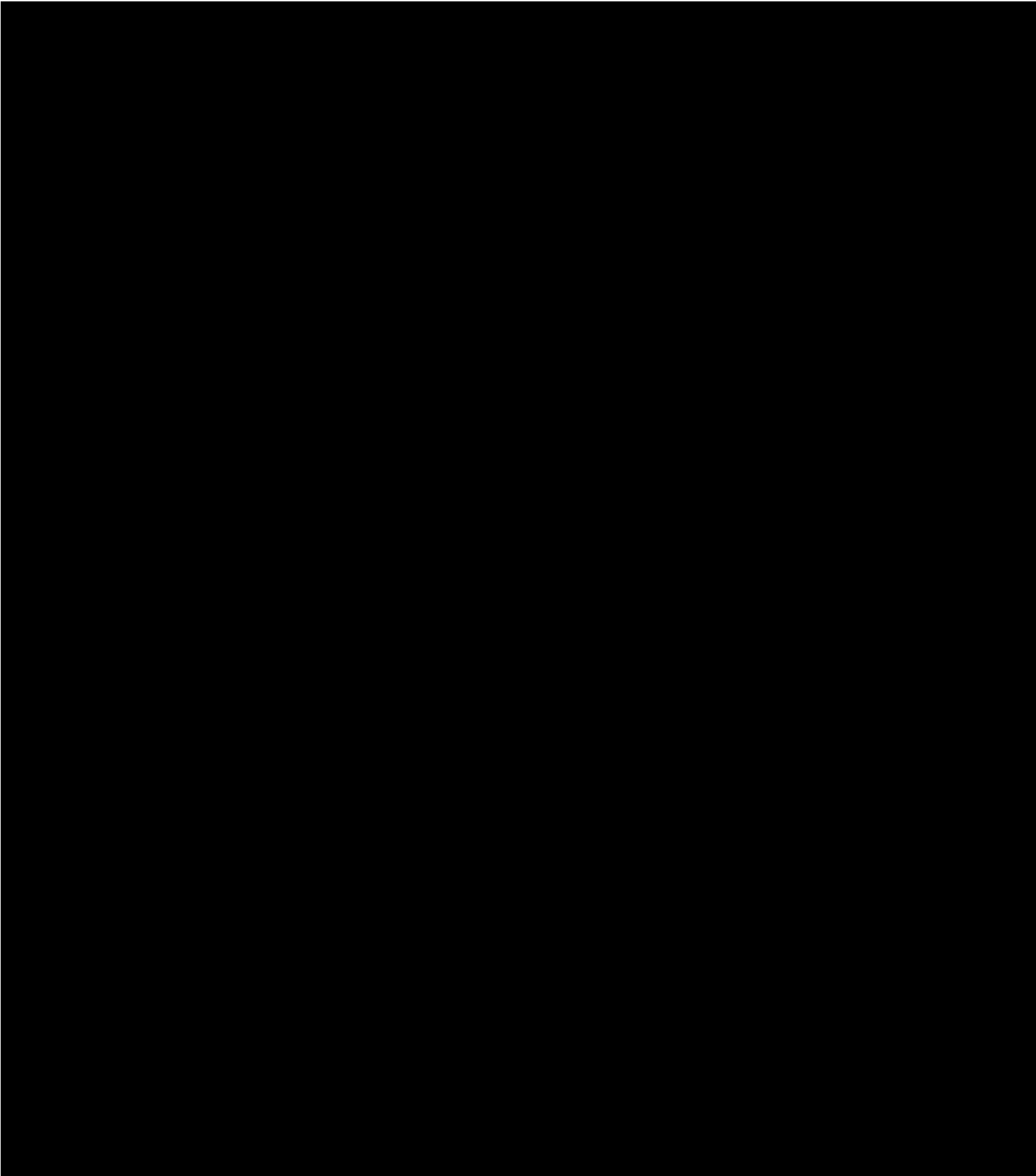
Source: Utica Ave Study

The IPOs also differed with respect to one-seat ride connectivity to the East and West Sides of Manhattan from each of the three Brooklyn A-Division southern termini (Table 7). Of note, IPO #5 is the only IPO that would provide a one-seat ride from Kings Plaza to both the East Side and West Side of Manhattan. IPOs #4 and #6 would continue to provide a one-seat ride from Flatbush Av Terminal to both the East Side and West Side of Manhattan, whereas IPOs #5 and #7 would not. Additional service changes compared to the No-Build Alternative include the fact that IPOs #4 and #5 would provide a one-seat ride from New Lots Av Terminal to the East Side of Manhattan (with express service in Brooklyn) instead of to the West Side of Manhattan (with local service in Brooklyn). IPO #7 is the only IPO that would provide a one-seat ride from New Lots Av Terminal to both the East Side and West Side of Manhattan.

Table 7: One-Seat Ride Connectivity for IPOs #4-#7

	No-Build	IPO #4 CBTC Baseline	IPO #5 Modified Hybrid	IPO #6 CBTC Baseline	IPO #7 Modified Hybrid
		Local Track Connection		Express Track Connection	
Kings Plaza to East Side of Manhattan	No	No	Yes	Yes	Yes
Kings Plaza to West Side of Manhattan	No	Yes	Yes	No	No
Flatbush Av to East Side of Manhattan	Yes	Yes	No	Yes	No
Flatbush Av to West Side of Manhattan	Yes	Yes	Yes	Yes	Yes
New Lots Av to East Side of Manhattan	No	Yes	Yes	No	Yes
New Lots Av to West Side of Manhattan	Yes	No	No	Yes	Yes

Source: Utica Ave Study



Summary of Differentiators

The above comparison of IPOs #4-#7 across a number of metrics demonstrated that there were several differentiators that emerged among the four IPOs. Specifically, the IPOs differed with respect to Nostrand Junction operations, operational metrics for the service along and to/from Utica Ave, implications for Brooklyn A-Division service, ridership forecasts, capital and O&M cost estimates, and cost effectiveness. Table 10 presents a summary of these differentiators based on the preceding discussion, with “+” used to denote positive attributes of the IPOs and “-” used to denote negative attributes of the IPOs.

Table 10: Summary of Differentiators for IPOs #4-#7

	IPO #4 CBTC Baseline	IPO #5 Modified Hybrid	IPO #6 CBTC Baseline	IPO #7 Modified Hybrid
	Local Track Connection		Express Track Connection	
Nostrand Junction Operations	- does not address existing chokepoint	+ eliminates existing chokepoint	- does not address existing chokepoint	+ eliminates existing chokepoint
Service Along Utica Ave	- reduction in service frequency compared to No-Build + highest end terminal OTP for subway lines to Kings Plaza	+ second highest end terminal OTP for subway lines to Kings Plaza (with greater TPH than IPO #4)	- lowest end terminal OTP for subway lines to Kings Plaza	- third in end terminal OTP for subway lines to Kings Plaza (almost a 10% decrease compared to IPO #5)
Service to/from Utica Ave	(no differentiator)	+ only IPO that offers one-seat ride from Kings Plaza to both East Side and West Side of Manhattan	- lowest travel time savings from Crown Heights-Utica Av Station to Nevins St	+ greatest travel time savings from Crown Heights-Utica Av Station to Nevins St
A-Division Service to/from Flatbush Av Terminal	(no differentiator)	+ more frequent service compared to No-Build - second largest increase in travel time from Flatbush Av Terminal to Nevins St - eliminates one-seat ride to East Side of Manhattan	(no differentiator)	+ more frequent service compared to No-Build - largest increase in travel time from Flatbush Av Terminal to Nevins St - eliminates one-seat ride to East Side of Manhattan
A-Division Service to/from New Lots Av Terminal	+ more frequent service compared to No-Build + greatest travel time savings from New Lots Av Terminal to Nevins St (due to change from local to express service)	+ second greatest travel time savings from New Lots Av Terminal to Nevins St (comparable to IPO #4) (due to change from local to express service)	- lowest travel time savings from New Lots Av Terminal to Nevins St (by multiple minutes)	+ adds express service and a one-seat ride to East Side of Manhattan
Overall A-Division Service	+ highest overall end terminal OTP	+ second highest overall end terminal OTP, also with >99% (with more TPH than IPO #4)	- Largest decrease in overall end terminal OTP (3.1%), but still 94.8%	- decrease in overall end terminal OTP (1.5%), but still 96.4%

	IPO #4 CBTC Baseline	IPO #5 Modified Hybrid	IPO #6 CBTC Baseline	IPO #7 Modified Hybrid
	Local Track Connection		Express Track Connection	
Ridership	- lowest number of linked trips on the project (total and by low-income households)	+ second highest number of new riders	- lowest number of new riders + second highest number of linked trips on the project (total and by low-income households)	+ highest number of new riders + highest number of linked trips on the project (total and by low-income households)
Capital Cost and Cost Effectiveness²⁰	<i>(no differentiator)</i>	<i>(no differentiator)</i>	- highest capital cost per new rider trip	<i>(no differentiator)</i>
O&M Cost and Cost Effectiveness	+ lowest O&M cost and lowest O&M cost per new rider trip	- highest O&M cost and highest O&M cost per new rider trip	+ second lowest O&M cost (comparable to IPO #4)	- second highest O&M cost (comparable to IPO #5)

Source: Utica Ave Study

²⁰ When considering both underground and aerial alignment options, as well as different options for the Local Track Connection for IPOs #4 and #5, there were no clear differentiators among the four IPOs with respect to capital cost and cost effectiveness other than the high capital cost per new rider trip associated with IPO #6.

7.2 RECOMMENDED RANKING OF IPOs #4-#7

Based on the above comparison of IPOs #4-#7, there were several key drivers that informed the resultant recommendation for the ranking of these four IPOs. A fundamental differentiator among the IPOs was that IPOs #5 and #7 would be preferable because they eliminate the Nostrand Junction chokepoint, whereas IPOs #4 and #6 do not. For IPOs #5 and #7, the loss of a one-seat ride from Flatbush Av Terminal to the East Side of Manhattan would be offset by an increase in service frequency (enabled by the Modified Hybrid Operating Plan) in addition to an improvement in end terminal OTP.

In comparing IPOs #5 and #7 as the two most preferable options among the four IPOs, IPO #5 emerged as a more favorable option based on several metrics. Specifically, IPO #5 would offer substantially better end terminal OTP to Kings Plaza than IPO #7 (98.7% vs. 89.6%). IPO #5 would also offer the second highest overall end terminal OTP for the Brooklyn A-Division (99.3%), and the highest among IPOs that include 60 total TPH. Additionally, IPO #5 was the only IPO that would offer a one-seat ride from Kings Plaza to both the East Side and West Side of Manhattan. For these reasons, IPO #5 was identified as the top ranked IPO among IPOs #4-#7, and IPO #7 was ranked second because unlike IPOs #4 and #6, IPO #7 would address the Nostrand Junction chokepoint.

Among IPOs #4-#7, IPO #4 was the least attractive option because it would result in a reduction in service frequency from Kings Plaza compared to the B46 SBS in the No-Build Alternative. Although IPO #4 performed better than IPO #6 for most metrics, the reduction in service frequency associated with IPO #4 rendered this option the least preferable among IPOs #4-#7. As such, IPO #6 was ranked third and IPO #4 was ranked fourth among the four IPOs.²¹

In summary, the recommended ranking of IPOs #4-#7 was as follows:

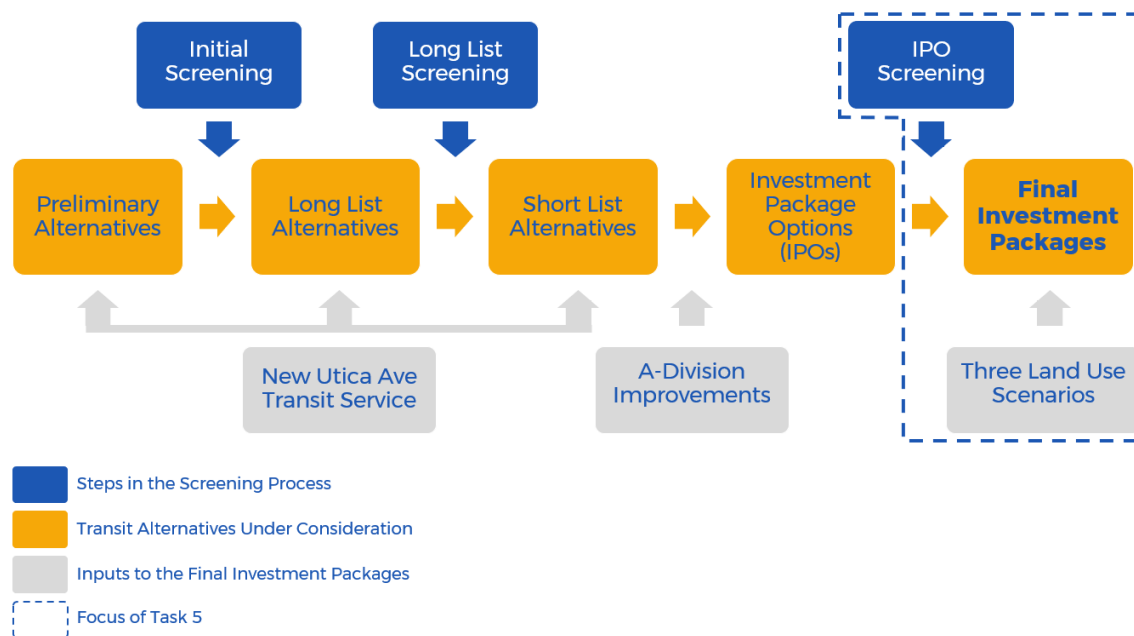
- **First: IPO #5** (Local Track Connection with Modified Hybrid Operating Plan);
- **Second: IPO #7** (Express Track Connection with Modified Hybrid Operating Plan);
- **Third: IPO #6** (Express Track Connection with CBTC Baseline Operating Plan); and
- **Fourth: IPO #4** (Local Track Connection with CBTC Baseline Operating Plan).

²¹ While IPOs #4 and #6 were ranked the lowest of the four IPOs because they would not address the Nostrand Junction chokepoint, no IPOs were eliminated in Task 4. However, the ranking of IPOs #4-#7 subsequently informed the selection of the Final Investment Packages in Task 5.

8 Conclusion & Next Steps

As discussed in this report, the ranking of IPOs #4-#7 represented the first step in a two-step IPO screening process. Building upon the work in this report, the subsequent work in Task 5—shown inside the dotted line on Figure 7—documented the process of selecting the Final Investment Packages and the resultant ridership forecasts using all three Land Use Scenarios. As discussed in the Task 5 report, the recommendations for the Final Investment Packages were informed by the ranking of IPOs #4-#7 and a targeted comparison of all 13 IPOs, with the intended outcome of a wide range of investment levels and concepts for improving transit service along, to, and from Utica Ave.

Figure 7: Alternatives Development & Screening Process — Remaining Steps to Select & Evaluate Final Investment Packages (in Task 5)



Source: Utica Ave Study

Note: Building upon the work in Tasks 3 and 4, the work in Task 5 reflected the steps of the alternatives development and screening process inside the dotted line of this graphic.